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Long range transport of PAHs with Asian dust

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Long range transport of policyclic aromatic hydrocarbons (PAHs) have been revealed in past decades in several locations in the world. However, there have been few reports revealing those from eastern Asain continent over Japan Sea even growing emissions of PAHs are expected there. Asian dust particles (KOSA) can accumulate anthropogenic sulfur and nitrogen oxide on the surface. PAHs may also be sorbed on the dust particles during transportation. To understand the impact of Asian dust particles on the environments, it is necessary to elucidate the content and transportation mechanisms of PAHs with Asian dust particles.

The possibility of Asian dust particles as a long range carrier of PAHs was investigated by collecting aerosol particles from April 2003 though a year in rural area of Kanazawa, Japan. Asian dust particles were collected in three sampling intervals: Dust period 1 (May 11 to 19), Dust period 2 (May 28 to April 9) and Dust period 3 (April 9 to 25) in 2004. Asian dust particles dominated in coarse particle size range (2.1-11 μm). PAHs in coarse and fine particles (<1.1 μm) were analyzed separately. Quantified PAHs and their abbreviations are as follows: Phenanthrene(Phe), Pyrene(Pyr), Benzo[a]anthracene(BaA), Chrysene(Chr), Benzo[b]fluoranthene(BbF), Benzo[k]fluoranthene(BkF), Benzo[a]pyrene(BaP), Benzo[g,h,i]perylene(BghiP).

Seasonal trend of PAHs in coarse and fine particles are shown in Figure 1. In this figure, the seasonal variation in PAHs concentrations in coarse and fine particles were well synchronized suggesting the source of them would have been same. In the Dust periods, coarse particles were selectively supplied in the sampling location while fine particles remained dominantly local origin. When PAHs concentrations in fine particles (that reflect PAHs of local origin) decreased while those in coarse particles increased (against the decreasing trend of local PAHs) in the Dust periods, the PAHs would have been supplied with Asian dust particles. The observed discordances are summarized in Table 1 as follows: When PAHs concentration of interest in coarse particles increased while that in the fine particles decreased compared to that in coarse and fine particles respectively in the previous sampling period, plus (+) sign is assigned in the table while negative (-) refers to the opposite situation. The blank in the table means they were synchronized. From the table, there were no analytical periods aside from Dust period 3 in that almost all PAHs showed same discordances ("+" sign) (except for Chr; Chr concentration in fine particles remained almost similar just before and during Dust period 3

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although that in coarse particles showed prominent increase in Dust period 3) suggesting significant amount of PAHs were transported with Asian dust particles in Dust period 3. Theoretical considerations developed in this study revealed that less volatile PAHs than BaP would hardly be accumulated on Asian dust particles in the atmosphere due to slow sorption rate. The source of those PAHs would have been originally polluted soil particles (e.g. around industrialized area in Loess plateau). Back trajectory analyses also revealed that Asian dust that in Dust period 3 would have come from around Loess plateau while the other would have been derived from arid and semi-arid regions in Mongolia and northern China.

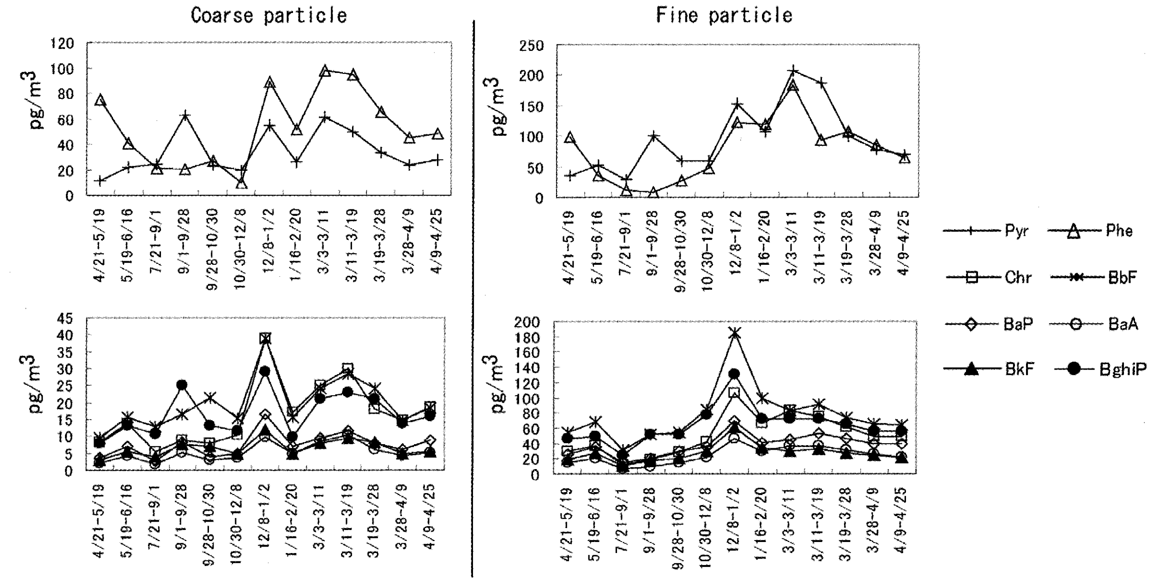

Figure 1. Seasonal trend of PAHs concentrations in coarse and fine particles

Table 1. Discordance in PAHs concentrations increase and decrease between coarse and fine particles

Analytical periods	Phe	Pyr	BaA	Chr	BbF	BkF	BaP	BghiP
5/19-6/16 (03)								
7/21-9/1		+						
9/1-9/28						—	—	
9/28-10/30			+			—		
10/30-12/8	—	—			—			—
12/8-1/2 (04)								
1/6-2/20								
3/3-3/11					+	+		
3/11-3/19				+				
3/19-3/28								
3/28-4/9								
4/9-4/25 (Dust period 3)	+	+	+		+	+	+	+